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IS/IEC 61262-3 (1994): Medical Electrical Equipment - Charactistics of Electro - Optical X-Rays Image Intensifiers, Part 3: Determination of the Luminance Distribution and Luminance Non -Uniformity [MHD 18: Imaging and Radiotherapy Equipment]

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भाग 3 ज्योतिर्मयता वितरण और ज्योतिर्मयता गैर-अनुरूपता ज्ञात करना

Indian Standard

MEDICAL ELECTRICAL EQUIPMENT — CHARACTERISTICS OF ELECTRO-OPTICAL X-RAY IMAGE INTENSIFIERS

PART 3 DETERMINATION OF THE LUMINANCE DISTRIBUTION AND LUMINANCE NON-UNIFORMITY

ICS 11.040.50

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NEW DELHI 110002

February 2012 **Price Group 5**

Ionizing Radiation Imaging and Radiotherapy Equipment Sectional Committee, MHD 18

NATIONAL FOREWORD

This Indian Standard (Part 3) which is identical with IEC 61262-3 : 1994 'Medical electrical equipment — Characteristics of electro-optical X-ray image intensifiers — Part 3: Determination of the luminance distribution and luminance non-uniformity' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Ionizing Radiation Imaging and Radiotherapy Equipment Sectional Committee and approval of the Medical Equipment and Hospital Planning Division Council.

This standard was first published in 1993 as IS 13729 by adopting IEC Pub 572 (1977) 'Determination of luminance distribution of electro-optical X-ray image intensifier' which had been withdrawn and replaced by IEC 61262-3 : 1994. This standard will, therefore, supersedes IS 13729 : 1993 and after the publication of this standard IS 13729 : 1993 shall be treated as withdrawn.

The luminance distribution and the luminance non-uniformity of the electro-optical X-ray image intensifier are determined from the measurements of the luminance over the area of the output image related to conditions of uniform X-irradiation in the entrance plane of the X-ray image intensifier. The method is intended for evaluating relatively large scale non-uniformity only. More local non-uniformities such as structure mottle are not considered in this standard.

Other parts of this standard are:

Part 1 Determination of the entrance field size
Part 2 Determination of the conversion factor
Part 4 Determination of image distortion (under adoption)

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviation. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker in the International Standard while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appear to the following International Standard for which Indian Standard also exists. The corresponding Indian Standard which is to be substituted in its place is listed below along with its degree of equivalence for the edition indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 788 : 1984[1] Medical radiology — Terminology	IS 13807 : 1994 Medical radiology — Terminology	Identical

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Publication.

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[1] Since revised in 2004.

(*Continued on third cover*)

Indian Standard

MEDICAL ELECTRICAL EQUIPMENT — CHARACTERISTICS OF ELECTRO-OPTICAL X-RAY IMAGE INTENSIFIERS

PART 3 DETERMINATION OF THE LUMINANCE DISTRIBUTION AND LUMINANCE NON-UNIFORMITY

1 Scope

This International Standard applies to ELECTRO-OPTICAL X-RAY IMAGE INTENSIFIERS for medical use, as components of diagnostic X-RAY EQUIPMENT.

This International Standard describes a method of determining the LUMINANCE DISTRIBUTION and LUMINANCE NON-UNIFORMITY of X-RAY IMAGE INTENSIFIERS related to conditions of uniform X-IRRADIATION in the ENTRANCE PLANE.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 788: 1984, *Medical Radiology - Terminology*

3 Terminology

3.1 *Definitions*

For the purposes of this International Standard, the following definitions apply together with those given in IEC 788. The definitions given below take preference over those given in IEC 788 when differences occur.

3.1.1 *XRII:* An abbreviation for ELECTRO-OPTICAL X-RAY IMAGE INTENSIFIER.

3.1.2 *ENTRANCE PLANE:* The plane perpendicular to the axis of symmetry of the XRII and grazing the part of the XRII, including its housing, that protrudes most in the direction of the RADIATION SOURCE.

3.1.3 *ENTRANCE FIELD:* For an XRII, the area in the ENTRANCE PLANE that can be used for the transmission of an X-RAY PATTERN under specific conditions.

3.1.4 *ENTRANCE FIELD SIZE:* For an XRII, the diameter of the field in the ENTRANCE PLANE that can be used at a specified SED for the transmission of an X-RAY PATTERN. For an XRII with more than one magnification mode, the ENTRANCE FIELD SIZE for each of the magnification modes shall correspond to the same diameter of the XRII OUTPUT IMAGE occurring with the largest ENTRANCE FIELD SIZE.

3.1.5 *SOURCE TO ENTRANCE PLANE DISTANCE (abbreviation: SED):* The distance between the FOCAL SPOT of the X-RAY TUBE and the ENTRANCE PLANE of the XRII.

3.1.6 *CENTRE OF THE OUTPUT IMAGE:* The centre of the smallest circle circumscribing the OUTPUT IMAGE.

3.1.7 *CENTRE OF THE ENTRANCE FIELD:* That point in the ENTRANCE PLANE which is imaged at the CENTRE OF THE OUTPUT IMAGE.

3.1.8 *CENTRAL AXIS:* The line perpendicular to the ENTRANCE PLANE passing through the CENTRE OF THE ENTRANCE FIELD.

3.1.9 Not used

3.1.10 *LUMINANCE NON-UNIFORMITY:* For an XRII, the difference of luminance between the CENTRE OF THE OUTPUT IMAGE and locations near the periphery of the OUTPUT IMAGE under specific conditions, expressed as a percentage of the luminance at the CENTRE OF THE OUTPUT IMAGE.

3.2 *Degree of requirements and reading instructions*

In this International Standard the auxiliary verb:

– "shall"	implies that compliance with a requirement is mandatory for compliance with the standard;
– "should"	implies that compliance with a requirement is strongly recommended but is not mandatory for compliance with the standard;
– "may"	implies that compliance with a requirement is permitted to be accomplished in a particular manner, for compliance with the standard;

and the following words have the meaning:

– "specific"	when used in combination with parameters or conditions: refers to a particular value or standardized arrangement, usually to those required in an IEC standard or a legal requirement; see IEC 788, rm-74-01.
– "specified"	when used in combination with parameters or conditions: refers to a value or arrangement to be chosen for the purpose under consideration and indicated usually in the ACCOMPANYING DOCUMENTS; see IEC 788, rm-74-02.
– "designed for"	when used in standards to characterize equipment, devices, components or arrangements: designates an intended and usually apparent purpose or use for the product.

4 Requirements

4.1 *Test set-up*

a) The SED shall be 100 cm ± 1 cm.

b) The FOCAL SPOT of the X-RAY TUBE shall be on the CENTRAL AXIS.

c) The distance between the FOCAL SPOT of the X-RAY TUBE and any ADDED FILTERS shall not exceed 33 cm.

d) The X-RAY FIELD shall cover the ENTRANCE FIELD entirely, but its area shall not exceed the ENTRANCE FIELD area by more than 10 %.

This limitation of the X-RAY FIELD shall be made by a DIAPHRAGM placed immediately in front of the ENTRANCE PLANE. The BEAM LIMITING DEVICE of the X-RAY SOURCE ASSEMBLY shall be used to limit the X-RAY BEAM on this DIAPHRAGM. The DIAPHRAGM shall provide an ATTENUATION RATIO of at least 100 for the quantity AIR KERMA RATE.

4.2 *X-RAY IMAGE INTENSIFIER - Operating conditions*

a) The XRII shall be operated under the conditions for NORMAL USE as specified by the manufacturer.

b) No ANTI-SCATTER GRID or protective cover shall be used.

c) In the case of multiple-field XRIIs, the measurement shall be made for the largest specified ENTRANCE FIELD. Measurements for other ENTRANCE FIELDS are optional.

4.3 *Input radiation*

a) The TOTAL FILTRATION of the incident X-RAY BEAM shall be 22,5 mm ± 0,5 mm of aluminium equivalent of which at least 20 mm is aluminium (99,9 % purity). The HALF-VALUE LAYER at the position corresponding to the CENTRE OF THE ENTRANCE FIELD shall be 7,0 mm Al ± 0,2 mm Al (99,9 % purity). This condition corresponds to an approximate X-RAY TUBE VOLTAGE of 75 kV.

b) The AIR KERMA RATE in the ENTRANCE PLANE shall be such that linear operation of the XRII and the detectors employed in the measurement is ensured. An AIR KERMA RATE of 1 $\mu Gy\ s^{-1}$ to 100 $\mu Gy\ s^{-1}$ is recommended.

c) The temporal fluctuations of the AIR KERMA RATE shall not impair the measurement uncertainty by more than 2 %. If the AIR KERMA RATE measurements or the luminance measurements are made at different time instances, the X-RAY TUBE output shall be monitored and the results of the measurements shall be corrected to meet this requirement.

d) The AIR KERMA RATE at any location in the ENTRANCE FIELD shall not be less than 70 % of the highest value of the AIR KERMA RATE in the ENTRANCE FIELD.

4.4 *TEST DEVICE*

Not used.

4.5 *Measurement equipment*

4.5.1 *Device for measuring the uniformity of the X-RAY FIELD*

a) Any device measuring a quantity which has a known relationship to the relative AIR KERMA RATE may be used, for example, a photomultiplier tube coupled to a scintillator or a NON-SCREEN FILM with a known sensitometric curve. The device shall have such a precision, that the error of measuring relative AIR KERMA RATE is 2 % or less. No particular specifications are required with respect to the absolute accuracy of these measurements.

b) The maximum diagonal of the effective measuring area of the device shall not exceed 10 % of the ENTRANCE FIELD SIZE.

4.5.2 *Device for measuring the luminance of the OUTPUT SCREEN*

a) Any device measuring a quantity which has a known relationship to the relative luminance may be used. The device shall have such a precision, that the error of measuring relative luminance is 2 % or less. No particular specifications are required with respect to the absolute accuracy of these measurements.

b) The device shall measure the relative luminance in the direction perpendicular to the plane defined by the OUTPUT SCREEN.

The acceptance cone of the detector shall be small enough to avoid errors when measurement approaches a dark edge.

c) The diagonal of the effective area of the measuring field shall be at least 0,1 mm and shall not exceed 5 % of the OUTPUT IMAGE diameter.

d) If the luminance is measured through a lens with a one- or two-dimensional image detector in fixed position, the lens vignetting, the detector non-uniformity and the non-linearity of its response shall be corrected for.

5 Determination of the LUMINANCE DISTRIBUTION and LUMINANCE NON-UNIFORMITY

5.1 *Preparation*

a) The requirements for the measurement set-up given in 4.1 shall be fulfilled.

b) The TOTAL FILTRATION of the RADIATION BEAM and the X-RAY TUBE VOLTAGE are adjusted according to 4.3 a) to obtain the required HALF-VALUE LAYER at the position corresponding to the CENTRE OF THE ENTRANCE FIELD according to 4.1.

5.2 *Measurement*

5.2.1 *Measurement of the X-RAY FIELD uniformity*

a) After the determination of the ENTRANCE PLANE and the CENTRE OF THE ENTRANCE FIELD, the XRII is removed from the X-RAY BEAM. No objects capable of scattering X-RADIATION shall remain in the X-RAY BEAM at a distance less than 50 cm from the ENTRANCE PLANE according to 4.1.

b) The measurements of the uniformity shall be made with the effective area of the measuring device in the ENTRANCE PLANE and parallel to it but without the XRII in the beam.

c) The AIR KERMA RATE is measured at those locations that correspond to the locations of subsequent luminance measurements of the OUTPUT SCREEN.

d) If the AIR KERMA RATE measurements at various locations are made at different time instances the X-RAY TUBE output shall be monitored.

5.2.2 *Measurement of the OUTPUT SCREEN luminance*

a) The XRII shall be positioned as stated in 4.1.

b) To measure the LUMINANCE DISTRIBUTION, the relative luminance of the OUTPUT SCREEN shall be measured along two orthogonal diameters of the OUTPUT SCREEN over a range covering at least 90 % of the corresponding ENTRANCE FIELD SIZE. The distances between successive points of measurements shall not be greater than those corresponding to 10 % of the ENTRANCE FIELD SIZE.

To measure the LUMINANCE NON-UNIFORMITY, the relative luminance of the OUTPUT SCREEN shall be measured at the CENTRE OF THE OUTPUT IMAGE and at four locations situated on two orthogonal diameters of the OUTPUT SCREEN and with a distance from the CENTRE OF THE OUTPUT IMAGE that corresponds to 90 % of the radius of the ENTRANCE FIELD.

c) If the luminance measurements at various locations are made at different time instances the X-RAY TUBE output shall be monitored.

NOTE - X-RAY TUBE output monitoring may be made also by monitoring the luminance of a fixed area of the OUTPUT SCREEN.

d) To correct the measured values of relative luminance for the non-uniformity of the X-RAY BEAM, the corresponding locations in the ENTRANCE PLANE and in the OUTPUT IMAGE shall be determined.

e) The device for measuring the AIR KERMA RATE shall be removed.

5.3 *Corrections*

If the measured values of relative luminance or relative AIR KERMA RATE at various locations correspond to different time instances, they shall be corrected for the temporal fluctuations of the incident AIR KERMA RATE to correspond to a temporally constant incident AIR KERMA RATE.

If the incident X-RAY FIELD non-uniformity, determined according to 5.2.1, exceeds 2 % of the maximum AIR KERMA RATE the relative luminance value of each location shall be divided by the relative AIR KERMA RATE at the corresponding location in the ENTRANCE PLANE to correct for the spatial non-uniformity of the X-RAY FIELD.

5.4 *Determination*

The LUMINANCE NON-UNIFORMITY shall be computed as

$$L_n = 100\ \% \times \tfrac{1}{4} \times \sum_{i=1}^{4} | L_c - L_i | \ / \ L_c$$

where L_c is the luminance at the CENTRE OF THE OUTPUT IMAGE, and L_i (i = 1 to 4) are the luminances at the four points near the periphery of the OUTPUT IMAGE, according to 5.2.2 b).

6 Presentation of the results

6.1 *Presentation of the LUMINANCE DISTRIBUTION*

a) The presentation of the LUMINANCE DISTRIBUTION shall include the following:

- XRII identification, e.g., generic type, model name or number.
- The LUMINANCE DISTRIBUTION indicated by curves or by a table of numerical values showing the relative luminance as a function of distance along a diameter for one or two diameters through the OUTPUT IMAGE. The distances shall be scaled to correspond to distances in the ENTRANCE PLANE. The relative luminance shall be given in per cent of the maximum value obtained.
- The results presented shall cover a range of at least 90 % of the ENTRANCE FIELD SIZE.
- If only one diameter is selected for stating the LUMINANCE DISTRIBUTION, it shall be the diameter showing the greatest variation of luminance in the OUTPUT IMAGE.

b) Unless otherwise specified, the

- ENTRANCE FIELD SIZE.

6.2 *Presentation of the LUMINANCE NON-UNIFORMITY*

a) The presentation of the LUMINANCE NON-UNIFORMITY shall include the following:

- XRII identification, e.g., generic type, model name or number.
- The LUMINANCE NON-UNIFORMITY as determined according to 5.4 and expressed in per cent.

b) Unless otherwise specified, the

- ENTRANCE FIELD SIZE.

7 Statement of compliance

a) If compliance with this standard for the determination of the LUMINANCE DISTRIBUTION of an X-RAY IMAGE INTENSIFIER is to be stated, it shall be indicated as:

- Luminance distribution: IEC 1262-3: 1994.

b) If compliance with this standard for the determination of the LUMINANCE NON-UNIFORMITY of an XRII is to be stated, it shall be indicated as:

- Luminance non-uniformity ...[1] IEC 1262-3: 1994.

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[1] Numerical value of the LUMINANCE NON-UNIFORMITY.

Annex A
(informative)

Terminology - Index of terms

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Term without definition	rm-..-..-
Name of earlier unit	rm-..-..•
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Annex A of this standard is for information only.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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